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U. S. Naval School of Aviation Medicine

U. S. NAVAL AIR STATION
PENSACOLA, FLORIDA

RESEARCH REPORT

THE RETENTION OF EFFECTS OF 'MASSED' AND 'DISTRIBUTED' VESTIBULAR STIMULATION AS INDICATED BY THE DURATION OF THE OCULOGYRAL ILLUSION

PROJECT NUMBER NM 001 063.01.33

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THE RETENTION OF EFFECTS OF 'MASSED' AND 'DISTRIBUTED' VESTIBULAR STIMULATION AS INDICATED BY THE DURATION OF THE OCULOGYRAL ILLUSION

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SUMMARY

An investigation was made of the effects of a 'massed' and a 'distributed' rotation series on two aspects of habituation: (1) the decrement in response duration within the habituation series (2) the retention of habituation. Following preliminary indoctrination, two groups of 10 subjects received 39 separate rotation trials in which the rotational and postrotational durations of the oculogyral illusion were reported. This series of trials, which constituted the habituation series, was 'massed' into a single period with one group, while, with the other group, it was 'distributed' over four half-hour, daily sessions. Tests of retention were made seven days after completion of the habituation series. Within the limits of this experiment, the response decrement produced by a 'massed' series is as least as great as that yielded by a 'distributed' series. However if there is a systematic difference in the retention produced by these two series, it is the 'distributed' series which yields the greater retention. An interesting inference which arises as a by-product of the experimental procedure is that visual stimulation has an habituatory effect which is specific to the directional component of the vestibular reaction in progress when the visual stimulation is introduced. Otherwise expressed, the habituatory effect of visual stimulation does not generalize to a vestibular stimulus with an opposite directional component.

INTRODUCTION

This paper is an experimental investigation of the influence of one independent variable, the distribution of 'practice,' on two aspects of habituation to rotation, the rate of habituation and the retention of habituation.

The term habituation is used herein with only one implication intended, viz., decrement in the vestibular reaction as a function of repetitive vestibular stimulation. In the present experiment, the duration of the oculogyral illusion (5) is used as an indicant of the vestibular reaction; however the following review of literature includes experiments in which other indicants, such as ocular nystagmus and head nystagmus, were utilized.

The retention of habituation to vestibular stimulation has not been studied extensively, particularly in human subjects. Partial recoveries from day to day, reported in some habituation studies, are suggestive of early loss of habituation. In this connection Griffith (7) has reported partial recovery from day to day in 16 college students and also in a group of white rats (6). Halstead offers striking confirmation to these observations:

It is well established that subjecting a group of birds (such as pigeons) to a program of ten or more periods of rotation, with an interpolated rest period of from one-half to two minutes, on successive days for ten to twenty days, will result in a reduction in the duration of postrotational nystagmus of from 50 to 60 per cent. It is not uncommon to observe half

this amount of reduction appearing at the end of the first day of rotation. Only part of the reduction obtained on a given day carries over and summates with that obtained on successive days (12, p. 6).

There are, however, indications of much more permanent response decrements from repetitive vestibular stimulation than these day to day comparisons would suggest. Griffith (8) reported that, after four and one-half years without 'practice,' one subject (Griffith) exhibited a certain amount of retention of habituation; moreover fewer trials were required to reduce the reaction to a given level than were necessary previously. In another study (14, pp. 90-93) of humans, two subjects showed almost complete retention after a lapse of one month, but one of these subjects was available after seven months and retention was not apparent. An unpublished study by Guedry, Solley and Corrigan, in which the oculogyral illusion (OGI) was used as an index of the vestibular reaction, is suggestive of less retention than was reported by either Holsopple or Griffith. After a series of 50 trials distributed over five days, the three subjects in this study exhibited complete retention with a two day rest. However between the 100th and 101st trial, a seven day rest was interposed and only about 50 per cent retention was manifest.

Interesting information on the retention of habituation to rotation has been supplied by studies of pigeons (3, 4, 12, 13, 19). Of these studies the most extensive and direct attacks on the problem of retention were the investigations conducted by Fearing (3, 4). He found that the effects of 60 elicitations of postrotational nystagmus in a single session (massed practice) were retained for a shorter period of time than the effects of 140 elicitations distributed over 14 successive days (distributed practice), even though differences were slight in the initial habituation under the two methods of practice.

The greater retention of habituation by the 'distributed practice' group was to be expected in terms of learning phenomena, and Fearing chose to interpret his data in this way. However because response measures were made on this group only on the first and fourteenth days of the practice series, it is not clear how soon the level of habituation exhibited on the fourteenth day was attained. For this reason, it is possible that the difference in retention between the two groups may be attributable to the difference in amount of practice rather than to the distribution of practice.

The general plan of the present experiment is to investigate the effects of 'massed' and 'distributed' rotation series, which have equal numbers of trials, on two aspects of habituation: (1) the decrement in response duration within the habituation series, and (2) the retention of this decrement. It should be borne in mind that whereas the literature reviewed, in many instances, dealt with lower animals as subjects and in most instances with vestibular nystagmus as an indicant of the vestibular reaction, the present research involves the use of humans as subjects and OGI (5) as an indicant of the vestibular reaction.

PROCEDURE

The principal item of apparatus was a Link trainer modified to rotate about its vertical axis. A strut projecting from the front of the fuselage provided rigid support for a 3" x 3" x 6" black box which was illuminated from within and tilted so that nine of the perforated edges of the box were visible from S's position. The intensity of two small lights within the box was adjusted until the box took on the appearance of a faint tridimensional target of insufficient intensity to make the room walls visible. In the cockpit was an iron stanchion supporting a bite-board which served to fix S's head at the center of rotation, a distance of two meters from the target. The trainer occupied the center of an equilateral, dodecagonal, light-proofed room. The walls were covered with a blue-grey fabric, pleated in a manner which gave the appearance of indistinct, one-inch, vertical stripes.

Rotation of the trainer was produced by means of three vacuum motors evacuated by a large electric blower motor which in turn was activated by E from a control panel in an adjoining room. In addition, this panel contained controls for angular velocity, rotation direction, overhead illumination, and intensity of the lights within the target box. The electrical switch which started and stopped the blower motor was such that whenever the propulsive force for rotation was initiated, the brake was simultaneously released, and conversely whenever this force was terminated the brake was simultaneously applied. The braking system consisted of a brake drum on the main shaft of the Link and a hydraulically controlled brake band. By adjusting a valve in the hydraulic system, greater or lesser pressure could be exerted on the brake drum, and thus negative acceleration could be varied. On the other hand positive acceleration could not be varied independently of rpm changes.

S indicated cessation of rotational and postrotational OGI first effects by pressing a key which flashed a light directly over a Standard Electric Timer in an adjoining control room. E recorded the time elapsed from the onset of acceleration until the light flashed (rotational first effect) and also from the onset of deceleration until the light flashed the second time (postrotational first effect).

The following conditions were utilized in this experiment:

Condition A. S was rotated in a clockwise direction for 61.5 sec. with controls set to achieve an angular velocity of 16 rpm. This yielded approximately 55 sec. of rotation at 16 rpm since about 6.5 sec. elapsed during the positive and negative acceleration periods, which lasted respectively 5.0 sec. and 1.5 sec. S observed the tridimensional target during and after rotation. Twenty seconds after S had reported cessation of the first postrotational effect, overhead illumination of the room was introduced to reduce dark adaptation. Otherwise and except for the faint light from the target which was insufficient to make the walls visible, the experimental room was in darkness throughout Condition A.

Condition B. This situation was the same as Condition A except that the experimental room was illuminated by an overhead light for a 5.0 sec. period which commenced 2.0 sec. after the cessation of rotation. The target was observed by S throughout the experimental period (i.e., before, during, and after the 5.0 sec. illumination period). The overhead light was not in the visual range of S and imparted an illumination of 1.04 apparent foot candles to walls of the room. The pleated fabric on the walls provided a background for the target of faint, one inch, vertical stripes.

Twenty men, 17 to 23 years of age, who were stationed at the U. S. Naval Air Station, Pensacola, Florida, served as subjects. None had previous experience in this or similar experiments. They were divided into two groups of 10 Ss each and were given the following experimental programs:

Group I, on the first day, received instructions for the various conditions followed by two indoctrination trials under Condition A. Between the first and second indoctrination trials, the importance of maintaining a constant criterion was stressed. Instructions are probably very important in this type of experimentation, and therefore all instructions are presented verbatim (infra p. 10). The indoctrination series was followed by four test trials and this completed the first day's program. These test trials, which were similar in all respects to Condition A except that the angular velocity was altered slightly, are relevant to considerations which will be taken up in another report (10).

Twenty-four hours later instructions were repeated, and the habituation series was commenced. It consisted of 39 trials in which Conditions A and B were regularly alternated. The habituation series commenced and ended with a Condition A trial, resulting in 20 Condition A trials and 19 Condition B trials within this series. After each of the first three sets of 10 trials, 5.0 min. rests were interposed; otherwise, rest intervals between trials were 60 sec. Thus the habituation series was completed within one period of approximately 1.5 hours duration. Five minutes later four test trials, identical to those given on day 1 and to be discussed in a separate report, were administered. This completed the program for the second day. Seven days later a test of retention, consisting of nine regularly alternated Condition A and B trials separated by 90 sec. rest intervals, was given. This retention series completed the program for Group I.

The Group II experimental program differed from that of Group I in only one respect: the habituation series was distributed over four consecutive days rather than being 'massed' into one session on one day. On the day following the indoctrination trials and the four test trials, this group received the first of the four daily sessions which constituted the habituation series. For any one S, these sessions were begun 24 hours apart instead of 5.0 min. apart as with Group I. The first three of these sessions consisted of 10 trials separated by 120 sec. rest intervals. The fourth session consisted of nine trials with Conditions A and B alternating, followed by four test trials to be discussed elsewhere (10). Thus the habituation series commenced and ended with Condition A just as with Group I.

The retention series was unchanged for this group and took place on the seventh day after completion of the habituation series.

At this time, it is appropriate to explain the use of Condition B in this experiment. These trials were interpolated to ensure the occurrence of habituation. Previous investigations (1, 9) had indicated that greater decrements in OGI, as a result of repetitive rotation, are obtained with interpolation of such trials in both 'massed' and 'distributed' series than where Condition A alone is used.

It is important to note that only the data obtained under Condition A are utilized in the following description of results.

RESULTS

Figure 1, which shows the mean duration of the first postrotational effect of OGI for each session, demonstrates clearly that both groups yield decrements in response duration over the entire habituation series. Each point on this graph is the mean of 50 raw scores, viz., five trials for each of 10 subjects. Because one full day intervened between sessions for each subject of Group II the data from this group are sufficient to demonstrate the retention of habituation effects from day to day under the conditions employed.

That the reduction over sessions, i.e., the series decrement for the habituation series, cannot be attributed to chance for either group is indicated in Tables 1, 2 and 3. This is true where the groups are combined (Table 1) as well as where the groups are treated separately (Tables 2 and 3). Further information provided by the analysis represented in Table 1 indicates (a) that the over-all difference between the groups, i.e., the two groups compared on the basis of an aggregate of the scores for all four sessions may be attributed to chance and (b) that the difference between groups with respect to the differences between sessions is also attributable to chance. In view of the systematic reduction of the OGI durations with successive sessions noticeable in Fig. 1, this second point is tantamount to saying that the apparent difference in the trend of the two curves is quite possibly a result of chance.

A closer inspection of the habituation series of the two groups was made by analysing the data of each session separately. Each session included five Condition A trials for each subject. Figure 2 presents the mean of each Condition A trial within each session. From this figure it is noticeable that Group II exhibits a partial recovery of response duration during each 24 hour rest, but within each session of the habituation series, this group always reaches a lower level than that attained on the preceding day. With Group II the differences between trials within each session considered separately are not attributable to chance. This is apparent from the separate statistical treatments indicated in Table 4.

Group I, which received only five minutes rest between each session of the habituation series, does not exhibit partial recovery with the

commencement of each new session of this series. Within session 1 and within session 2, differences between trials are pronounced and statistically reliable. However unlike Group II, differences between trials within sessions 3 and 4 of the habituation series are slight and easily attributable to chance. Apparently a program of 'massed' practice such as that used with Group I yields little response decrement after the first 20 trials. Table 5 provides ready reference to the statistical analyses made within sessions for Group I.

Four separate comparisons of Groups I and II were made on the basis of the five Conditions A trials within each of the four sessions. The overall difference between groups for any one session can be attributed to chance. (Tables 6, 7, 8, 9). From inspection of Fig. 2, this is not surprising for session 1 but it is surprising for sessions 2, 3 and 4. That these differences between groups are statistically unreliable is indicative of the pronounced difference between subjects apparent in Table 11. The fact that the Trials by Groups interaction (Table 9) is significant in the comparison of groups on the basis of session 4 data is indicative of the lack of differences between trials within Group I, and the corresponding pronounced difference between trials within Group II during session 4.

Retention. In order to ascertain the statistical reliability of the retention of habituation effects, the corresponding trials of the first session of the habituation series and the retention series were compared by use of t tests for related measures. For example, Trial 1 of session 1 of the habituation series was compared with Trial 1 of the retention series, etc. This was done separately for the two groups (Table 10). From these analyses, it is concluded that both groups exhibited retention of habituation. Figures 1 and 2 suggest that in relation to the level reached during the habituation series, Group II may have exhibited superior retention. In order to make a comparison of the Groups with regard to this matter, scores were computed by taking the ratio of the session 4 mean to the mean of the retention series for each subject.

Comparison of the groups on the basis of these scores was made by the t test. The value of t was 1.94 and for 18 degrees of freedom this value lies between t values required for the 0.05 and 0.10 levels of significance. In view of the fact that the difference obtained is in the direction predicted by past experiments, it might be considered appropriate to use a one-tailed test of significance in which case the difference between Groups I and II would be regarded as statistically reliable. The writer is not convinced of the practical significance of such statistical maneuvers. Although the data are suggestive of differences as predicted by previous work, the reliability of these differences remains to be established by further experimentation.

In the preceding analyses, only the postrotational data have been examined. This report is mainly concerned with postrotational results because past experimentation has indicated little difficulty with these reports even with inexperienced subjects, whereas the rotational results were, (i.e. vestibular reaction associated with commencement of rotation)

on occasions, subject to question. However, in the present experiment this difficulty with rotational reports did not arise, and the rotational data have a special significance for the following points.

The per cent reduction of the rotational effect, based on the first and last trials of the habituation series, were 21.2% and 18.3% for Groups I and II respectively whereas the corresponding values for the postrotational data were 46.9% and 47.2%. The differences in reduction between rotational and postrotational responses, either absolute reduction or per cent reduction, cannot be attributed to chance ($\underline{P} < 0.05$ in every comparison). In another experiment to be reported later (11), a group which did not receive Condition B, but which was treated comparably in other respects, exhibited 20.4% reduction for the rotational reaction and 21.4% reduction for the postrotational reaction, a difference which is easily attributable to chance. These considerations suggest strongly that with respect to habituation the influence of the Condition B overhead light, which was introduced exclusively during the postrotational reaction, was specific to the directional component of the vestibular reaction. Otherwise expressed, the habituatory effect of visual stimulation apparently does not generalize to a vestibular stimulus with an opposite directional component. Since it has been held (16) that the rotational reaction for one rotation direction is equivalent to the postrotational reaction for the opposite rotation direction, the kind of visual stimulation afforded by Condition B might well be an explanation of unequal habituation of the postrotational reactions for 'practiced' and 'unpracticed' rotation directions reported in some studies (cf. Holsopple, 16). This possibility will be discussed in more detail in a later report (11).

An experiment by Clark and MacCorquodale (2), in which the OGI was used as a dependent variable, should be noted in relation to the present results. They found little if any decrement in response duration in three subjects where mean scores on successive days were compared. The rotational effects in the present experiment, which were subject to the same conditions of visual stimulation as those used by Clark and MacCorquodale, present a similar picture. Some subjects in Group II exhibit little or no day to day retention of the slight decrements in duration of the rotational effects within days, and the group as a whole exhibits such slight retention after one week that the difference between the mean of the retention series and the first session of the habituation series for rotational data cannot be considered reliable ($\underline{P} > 0.2$). These considerations, in conjunction with the fact that the postrotational data reveal a substantial decrement and substantial retention (difference between the mean of the first session and the retention series for the postrotational data is reliable, $\underline{P} < 0.01$), suggest that the visual stimulation afforded by the Condition B trials may influence retention as well as the amount of initial response decrement. It is of course possible that retention is dependent upon amount of decrement irrespective of visual stimulation.

DISCUSSION OF RESULTS

Within the limits of the present experiment, it is questionable that the reduction in duration of OGI under 'massed' trials exceeds the reduction produced by 'distributed' trials. It is also questionable that there is any difference between the retention of habituation produced by 'massed' trials and that produced by 'spaced' trials. However if a systematic difference in retention is present, it is the 'spaced' group which exhibited superior retention. This would be in agreement with the results Fearing (3, 4) obtained, and would substantiate his interpretation that the difference in retention exhibited by his two groups was due to the manner in which the trials were distributed. However it is to be emphasized that the differences between groups found herein were not nearly so clear cut as those obtained by Fearing.

A notable difference between these experiments is the fact that Fearing found greater retention after five months with his "distributed practice" group than was obtained in the present study after only one week. Aside from the difference in types of subjects and the difference in the indicants of the vestibular reaction used in the two studies, this difference in retention could easily result from Fearing's use of an habituation series which was 3.5 times as long as that used in the present study. The design of our study called for equating the number of trials in the habituation series. This meant that Group I ('massed' practice) was the limiting factor since preliminary research had revealed that over 40 trials massed into one session would be highly disagreeable to volunteer subjects.

It is possible that the two groups would have been more clearly differentiated with regard to retention if the habituation series had been longer (or if the retention series had been delayed for another week). Although there was very little difference in the overall Group means between sessions 3 and 4, the persistence of Group II in showing a pronounced decrement within session 3 and within session 4 seems indicative of the possibility for further response decrement with this group. On the other hand, the 'massed' group does not exhibit response decrement either within or between sessions 3 and 4. Hence extention of the habituation series of both groups may have resulted in a greater differentiation of the groups.

It should be noted that the results considered herein are analagous, at least, to certain considerations in the field of learning. Spence (18, p. 713) has indicated that "whereas conditioning is superior under spaced trials..., extinction is faster (or as fast) under 'massed' trials." Hull attempts (17) to account for extinction phenomena in terms of two components, "reactive inhibition" and "conditioned inhibition." The former is assumed to accumulate with the occurrence of each response and to dissipate fairly rapidly. The latter is assumed to be the conditioning of a tendency not to respond which is more permanent in nature. Hence experimental extinction should be hastened by the massing of trials, because "reactive inhibition" has less opportunity to dissipate. However where comparable levels of extinction are produced by 'massed' and 'spaced' trials,

the former should yield poorer retention of extinction since the response reduction from 'massed' trials would receive relatively larger contributions from the temporary component than would be received by the response reduction produced by 'spaced' trials. It is interesting to note that the results of this study and those obtained by Fearing suggest that retention of habituation to rotation with 'massed' and 'distributed' trials conforms fairly well with the predictions inferred from Hull's theory of extinction. This of course does not mean that habituation to rotation should necessarily be classified as an extinction phenomenon. However the analogy seems worthwhile in view of the many attempts in the past to relate vestibular habituation to learning phenomena.

INSTRUCTIONS

Condition A Instructions. "You will be rotated to the right in the trainer for one minute. It is important that you look at the target light and that you bite the bite-board during and after rotation until you are told to rest. The bite-board is to prevent head movements which would cause you discomfort and interfere with your observations. As rotation commences you will feel as though you're rotating to the right, and the target light will appear to be going to the right with you. After a while the motion of the target to the right will appear to stop and, at this time, you may no longer feel that you are rotating. As soon as the motion of the target to the right stops, press the response key. A short time after this, you may notice that the target appears to be moving to the left, and you may feel that you are rotating to the left. Don't wait for this to occur; be sure to press the key as soon as the apparent motion of the target to the right ceases. After a while, rotation of the trainer will be stopped and the target will appear to move fairly rapidly to the left. As soon as the target appears to have stopped moving to the left, press the response key once again. Just as during rotation, do not wait for a reversal of direction; press the key as soon as the apparent motion to the left ceases. You will be given a warning about 10 sec. before I stop you. This warning is given just so you won't be surprised by the stop. Do not answer me when I give the warning because you might move your head.

Remember, look at the target, bite the bite-board, and press the response key for the two situations indicated, once during rotation when apparent motion of the target to the right ceases, and once after rotation when the apparent motion of the target to the left ceases.

There is no reason to expect ill effects from the rotations you will receive. Many people have been subjected to these conditions in this trainer, and none have reported any discomfort. Do you full understand these instructions?"

Condition B Instructions. "This situation will be the same as the previous one except that the overhead light will be turned on for a brief interval two seconds after the trainer has stopped. After the overhead light has been turned off, report, by pressing the key, as soon as the motion of the target light to the left has ceased. In the event that, after the light has been turned off, you do not see any movement of the target to the left, press the response key immediately. Your task is the same as it was before. During rotation report as soon as the motion of the target to the right ceases, and then after rotation report as soon as apparent motion of the target to the left has ceased."

Instructions Pertaining to the Criterion for Reporting. "You can see from the practice trial you just completed that it would be possible for you to report too soon or too late on any given trial. Some people worry about this, and, thinking that on one trial they have reported too soon, they decide to wait a longer time on the next trial, or vice versa.

Don't worry about such things! Take each trial as it comes; do your best to catch the end point, and then don't worry about it. If you know that you hit the key too soon or too late on any one trial, don't try to 'make up' by reversing the error on the next trial. Just take each trial as it comes and do your best.

Did you note the second effects during and after rotation? (These effects were described again.) Some people notice the second effects for the first time in the middle of a series and decide that they will make sure the first effect has ended by waiting for the second to commence. I do not want you to do this because the beginning of the second effects are more difficult to report than the end of the first effects. Remember, during rotation report as soon as the motion of the target to the right ceases, and then after rotation report as soon as the apparent motion of the target to the left ceases.

The best way to accomplish accurate reporting is by concentrating on each trial as it comes up and by not worrying about the previous trials."

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Table 1

Variance Analysis of Mean Scores From Each Subject for Each Session of the Habituation Series: Comparison of Groups I and II

Source	Σx^2		df		Mean Square	F
Between Groups	86.53		1		86.53	0.87
Pooled Between Ss	1786.40		18		99.24	
Total Between Ss		1872.93		19		
Between Sessions	458.43		3		152.81	47.46
Sessions x Groups	10.64		3		3.55	1.10
Pooled: Ss x Sessions	174.14		54		3.22	
Total Within Ss		643.21		60		
Total		2516.14		79		

Table 2

Variance Analysis of Mean Scores From Each Subject for Each Session of the Habituation Series: Comparison of Sessions Within Group I

Source	Σx^2	df	Mean Square	F
Between Ss	871.80	9	96.87	28.41
Between Sessions	286.65	3	95.55	28.02
Ss x Sessions	91.97	27	3.41	
Total	1250.42	39		

Table 3

Variance Analysis of Mean Scores From Each Subject for Each Session of the Habituation Series: Comparison of Sessions Within Group II

Source	Σx^2	df	Mean Square	F
Between Ss	914.60	9	101.62	33.43
Between Sessions	182.41	3	60.80	20.00
Ss x Sessions	82.17	27	3.04	
Total	1179.18	39		

Table 4

Variance Analyses of the Group II Raw Data for Each Session of the Habituation Series

Session	Source	Σx^2	df	Mean Square	F
1	Between Ss	1836.97	9	204.11	86.12
	Between Trials	203.40	4	50.85	21.45
	Remainder	85.36	36	2.37	
	Total	2125.73	49		
2	Between Ss	1114.71	9	123.86	30.51
	Between Trials	124.10	4	31.02	7.64
	Remainder	146.33	36	4.06	
	Total	1385.14	49		
3	Between S	1173.56	9	130.39	32.35
	Between Trials	65.64	4	16.41	4.07
	Remainder	145.24	36	4.03	
	Total	1384.44	49		
4	Between Ss	871.81	9	96.87	53.22
	Between Trials	55.43	4	1.82	7.62
	Remainder	65.48	36		
	Total	992.72	49		

Table 5

Variance Analyses of the Group I Raw Data for Each Session of the Habituation Series

Session	Source	Σx^2	df	Mean Square	F
1	Between Ss	1258.83	9	138.87	30.45
	Between Trials	226.71	4	56.68	12.43
	Remainder	164.18	36	4.56	
	Total	1649.72	49		
2	Between Ss	897.97	9	99.77	26.96
	Between Trials	106.03	4	26.51	7.16
	Remainder	133.35	36		
	Total	1137.35	49		
3	Between Ss	1192.93	9	132.55	47.51
	Between Trials	11.72	4	2.93	1.05
	Remainder	100.58	36	2.79	
	Total	1305.23	49		
4	Between Ss	1424.50	9	158.28	63.06
	Between Trials	11.71	4	2.93	1.17
	Remainder	90.44	36	2.51	
	Total	1526.65	49		

Table 6

Variance Analysis of Session One of the Habituation Series: Comparison of Groups I and II

Source	Σx^2		df		Mean Square	F
Between Groups	22.18		1		22.18	0.1
Pooled Between Ss	3095.80		18		172.99	
Total Between S		3117.98		19		
Between Trials	408.19		4		102.05	29.49
Trials x Groups	21.93		4		5.48	1.58
Pooled Ss x Trials	249.53		72		3.46	
Total Within Ss		679.65		80		
Total		3797.63		99		

Table 7

Variance Analysis of Session Two of the Habituation Series: Comparison of Groups I and II

Source	Σx^2		df		Mean Square	
Between Groups	196.28		1		196.28	1.76
Pooled Between Ss	2012.68		18		118.82	
Total Between S		2208.96		19		
Between Trials	212.23		4		53.06	13.68
Trials x Groups	17.90		4		4.47	1.15
Pooled Ss x Trials	279.68		72		3.88	
Total Within Ss		509.81		80		
Total		2718.77		99		

Table 8

Variance Analysis of Session Three of the Habituation Series: Comparison of Groups I and II

Source	Σx^2		df		Mean Square	F
Between Groups	136.65		1		136.65	1.04
Pooled Between Ss	2366.49		18		131.47	
Total Between Ss		2503.14		19		
Between Trials	60.85		4		15.21	4.46
Trials x Groups	16.53		4		4.13	1.21
Pooled Ss x Trials	245.82		72		3.41	
Total Within Ss		323.20		80		
Total		2826.32		99		

Table 9

Variance Analysis of Session Four of the Habituation Series: Comparison of Groups I and II

Source	Σx^2		df		Mean Square	F
Between Groups	111.93		1		111.93	0.88
Pooled Between Ss	2296.32		18		127.57	
Total Between Ss		2408.25		19		
Between Trials	43.82		4		10.96	5.07
Trials x Groups	23.32		4		5.83	2.70
Pooled Ss x Trials	155.92		72		2.16	
Total Within Ss		223.06		80		
Total		2631.31		99		

Table 10

Comparison of Corresponding Trials in the Habituation Series' First Session and the Retention Series by Use of t Tests for Related Measures*

Group	Trial	Session One Means	Retention Series Means	t	P
	1	20.8	18.3	2.40	.05
	3	20.1	15.0	3.20	.02
I	5	16.6	14.3	1.23	>.10
	7	15.9	12.9	2.81	.05
	9	16.0	12.7	1.78	>.10
	1	22.1	16.8	8.76	.001
	3	19.7	16.4	3.22	.02
II	5	18.6	15.0	3.98	.01
	7	17.7	14.3	3.57	.01
	9	16.1	13.4	2.20	>.10

* df = 9 for all t tests in Table 10

Table 11

Raw Scores obtained under Condition A for Each Subject in both Groups of Experiment One

		Habituation Series																				Rentention Series				
Group	S	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	1	3	5	7	9
	1	23.6	21.0	23.1	20.9	19.8	21.8	19.0	18.9	18.2	17.7	19.5	17.9	15.5	16.3	16.4	16.5	17.2	18.2	17.4	19.2	24.3	24.5	23.0	21.3	23.2
	2	14.5	14.1	10.3	10.5	10.2	10.0	9.5	6.6	7.3	8.0	7.1	6.9	6.8	6.1	5.9	6.3	5.9	6.6	5.8	6.1	13.0	9.0	8.7	7.9	7.0
	3	21.0	17.6	16.3	14.0	13.8	14.9	14.3	12.0	12.2	12.4	13.3	14.1	13.8	14.7	11.0	16.4	11.9	13.8	10.8	11.1	13.4	15.1	13.6	12.8	11.3
	4	25.8	23.5	21.2	12.6	19.8	21.0	12.2	10.9		5.0	8.9	6.0	3.8	6.3	3.7	4.8	4.3	4.7	4.3	4.6	22.8	12.9	5.0	5.0	4.3
I	5	9.4	8.3	8.4	9.2	9.1	8.3	5.4	6.7	7.5	6.5	6.4	5.7	4.7	7.9	6.0	4.8	6.8	4.5	5.2	6.4	8.5	5.3	7.4	4.8	4.0
	6	29.8	30.4	28.4	24.0	24.9	21.6	19.1	19.2	20.9	20.6	19.1	20.0	20.8	16.0	20.9	15.7	23.2	19.4	21.0	16.0	23.6	21.4	21.1	20.0	18.3
	7	24.5	22.8	18.7	20.4	21.4	18.1	16.0	17.2	14.1	16.8	17.4	18.8	18.3	18.9	12.9	17.3	20.8	17.1	18.3	19.7	26.9	24.2	24.5	24.0	26.9
	8	19.8	18.9	11.5	14.5	13.8	12.2	8.9	10.4	9.8	7.5	9.0	8.1	5.6	5.6	6.7	7.3	6.6	6.3	6.3	6.8	13.1	10.7	10.8	9.6	7.8
	9	21.0	21.4	14.7	14.7	13.7	15.6	12.2	11.0	11.9	11.7	11.0	11.3	13.1	12.2	10.1	12.1	11.7	10.0	9.5	9.8	20.2	16.0	17.4	12.4	13.1
	10	18.8	22.9	13.8	18.3	13.0	14.8	12.8	11.8	10.3	11.1	9.5	7.8	10.6	9.7	12.8	9.9	14.6	10.8	12.1	10.8	17.2	10.9	11.7	11.3	11.0
	S	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	1	3	5	7	9
	1	27.0	24.6	23.6	21.9	21.5	21.3	20.9	16.1	18.8	19.8	18.2	16.1	17.4	16.9	14.7	16.9	16.8	18.7	15.7	16.1	18.7	19.2	19.3	14.9	15.9
	2	16.9	15.1	13.7	14.4	12.9	11.7	12.3	13.3	11.5	11.4	10.1	13.8	10.8	9.8	9.2	13.6	13.4	12.4	10.0	9.5	12.7	11.2	9.9	8.5	7.6
	3	21.9	12.9	16.9	14.3	13.5	15.6	19.0	17.9	18.4	14.7	16.1	13.9	11.6	12.0	12.8	11.8	11.2	8.2	12.3	6.5	17.9	10.5	15.4	11.4	9.9
	4	28.8	27.4	25.9	26.7	24.8	25.8	25.1	18.5	21.8	18.9	19.9	20.5	19.6	18.2	18.6	19.5	20.4	18.3	17.7	17.2	21.4	21.8	17.8	18.9	17.2
II	5	21.4	20.8	19.7	19.5	16.1	19.1	15.0	14.5	16.1	15.3	15.2	17.5	15.8	14.0	14.0	14.2	14.9	13.9	13.0	11.9	16.1	15.7	15.3	16.3	15.2
	6	24.3	20.6	16.9	16.5	12.9	17.5	15.3	13.6	12.8	10.9	15.8	14.8	13.5	14.1	12.7	15.7	12.5	12.1	12.4	12.5	17.4	23.3	18.5	17.2	17.3
	7	30.6	27.5	26.2	24.2	24.0	27.4	23.4	20.6	23.8	15.5	28.4	25.4	19.2	15.9	25.3	23.0	20.4	20.9	19.3	19.1	26.7	22.7	21.3	21.1	17.4
	8	25.7	27.5	24.5	21.8	19.7	24.4	20.0	17.9	15.3	14.2	17.0	10.0	9.8	8.4	8.6	17.8	14.9	15.8	15.7	9.6	22.1	19.8	17.9	17.7	17.0
	9	11.1	9.5	9.0	9.0	9.8	9.2	9.9	8.9	8.8	9.1	9.0	9.6	8.6	9.3	8.3	8.8	10.8	8.3	8.3	7.7	8.5	11.1	8.4	9.7	8.5
	10	13.2	10.8	9.8	8.4	5.5	9.3	9.4	7.3	6.5	7.2	6.0	4.0	6.3	5.8	5.3	6.0	6.8	6.4	7.2	6.4	6.6	8.2	6.6	7.5	7.7

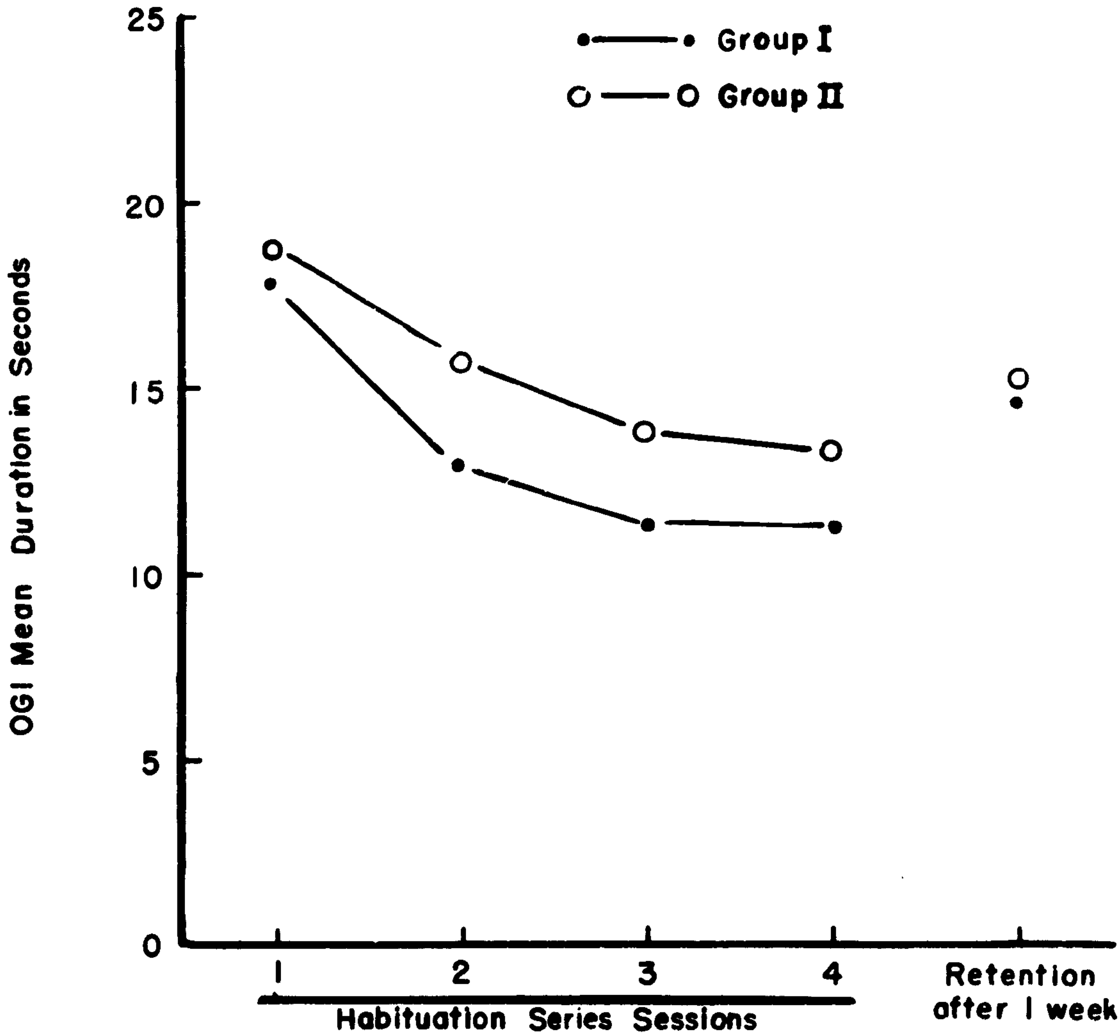

FIG. 1 SERIES DECREMENT AND RETENTION AS SHOWN BY THE GROUP MEANS FOR EACH SESSION OF THE HABITUATION SERIES AND FOR THE RETENTION SERIES.

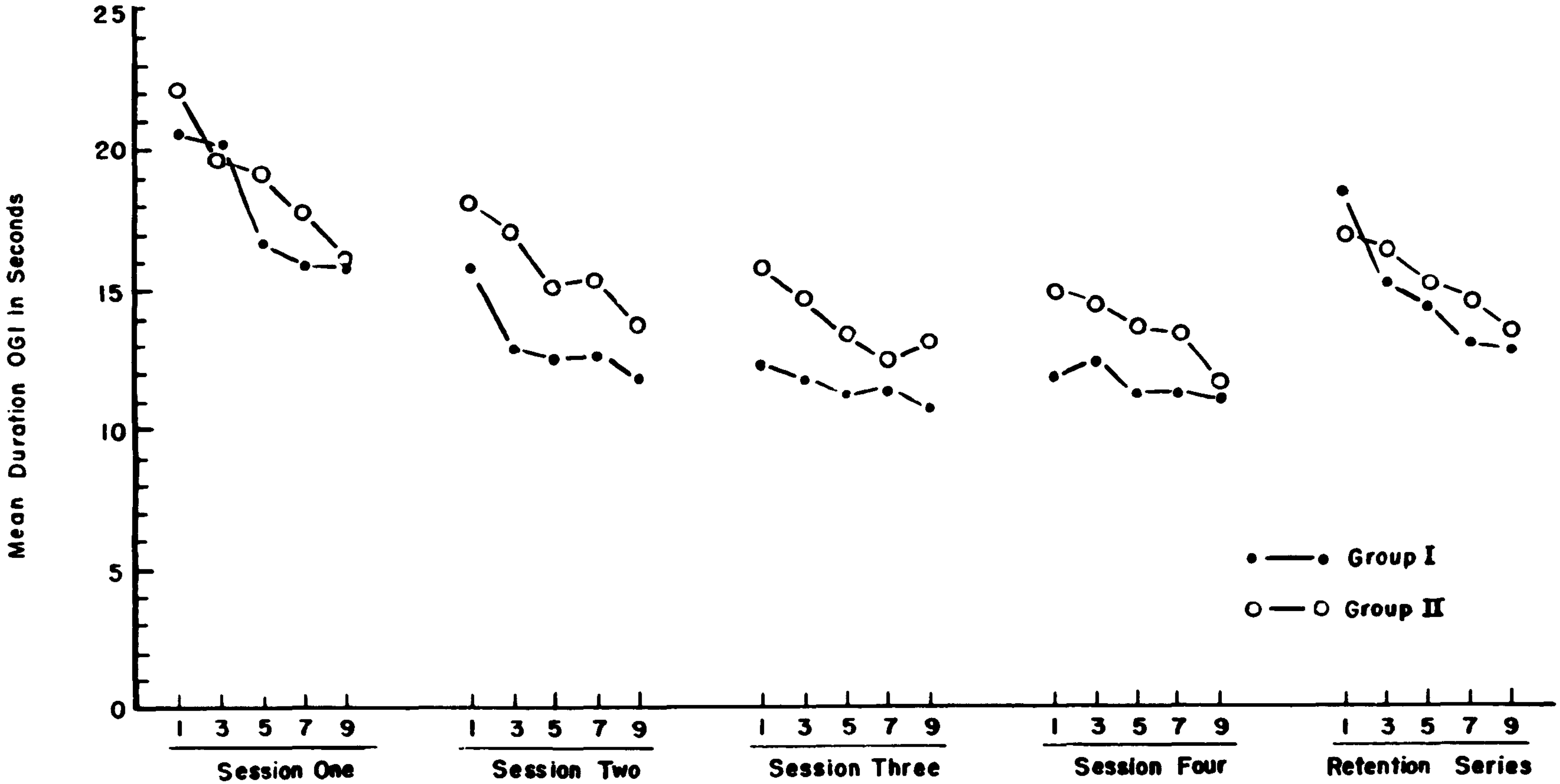

FIG. 2. SERIES DECREMENTS WITHIN SESSIONS AND OVER SESSIONS AS REVEALED BY CONDITION A TRIALS. TIME BETWEEN SESSIONS WAS 5 MINUTES FOR GROUP I AND 24 HOURS FOR GROUP II. ONE WEEK INTERVENED BETWEEN SESSION 4 AND THE RETENTION SERIES.